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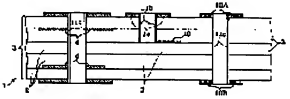
(54) PRINTED WIRING BOARD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a printed wiring board, where the existence and stress distortion on not only the surface layer part of the board but also on an inner layer part are measured and various influences by means of distortion can be dissolved at measuring the state change of a distortion gauge due to distortion by stresses in the printed wiring board.
SOLUTION: In a printed wiring board 1 formed of a board 3, where plural insulating boards 2 are stacked and a conductor pattern formed on the surface layer of the board 3, metal foil 10 whose conductor resistance change is large is buried in the inner layer of the board 3. Measuring electrodes 15 for connecting them to metal foil 10 are arranged on the surface of the board 3.



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CLAIMS

[Claim(s)]
[Claim 1] the printed wired board which consists of the substrate which carried out the laminating of two or more electric insulating plates, and the conductor pattern of this substrate formed in the surface at least -- setting -- the inner layer of the above-mentioned substrate -- a conductor -- the printed wired board to which resistance change is characterized by laying a big metallic foil underground.
[Claim 2] The printed wired board according to claim 1 characterized by having arranged the electrode for measurement for connecting with the above-mentioned metallic foil on the surface of the above-mentioned substrate.
[Claim 3] the above -- a conductor -- the printed wired board according to claim 1 or 2 to which resistance change is characterized by using nickel as a big metallic foil.
[Claim 4] The printed wired board according to claim 1, 2, or 3 characterized by forming the above-mentioned metallic foil on an electric insulating plate by photo etching.
[Claim 5] Claims 1, 2, and 3 characterized by having arranged two or more above-mentioned metallic foils in the location of the arbitration on one electric insulating plate which constitutes the above-mentioned substrate, or a printed wired board given in four.
[Claim 6] Claims 1, 2, 3, and 4 characterized by setting up the sense of each metallic foil in the many directions while arranging two or more above-mentioned metallic foils on one electric insulating plate, or a printed wired board given in five.
[Claim 7] The printed wired board according to claim 1, 2, 3, 4, 5, or 6 characterized by having arranged the above-mentioned metallic foil, respectively in the location of the arbitration on a different electric insulating plate which constitutes the above-mentioned substrate.
[Claim 8] Claims 1, 2, 3, 4, 5, and 6 characterized by connecting the above-mentioned metallic foil and the electrode for measurement formed in the substrate surface in a through hole, or a printed wired board given in seven.
[Claim 9] The printed wired board according to claim 1, 2, 3, 4, 5, 6, 7, or 8 characterized by forming by plating solder in the hole which formed the above-mentioned through hole in the above-mentioned substrate.
[Claim 10] the printed wired board which consists of the substrate which carried out the laminating of two or more electric insulating plates, and the conductor pattern of this substrate formed in the surface at least -- setting -- a conductor -- the printed wired board characterized by for resistance change having arranged the big metallic foil, respectively at the front face of the above-mentioned substrate, and this front-face side metallic foil and a corresponding substrate rear face, and connecting between both metallic foils in a through hole.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] the conductor of the metal body which prepared changes of state, such as distortion by the stress which produces this invention in a printed wired board, in the patchboard inner layer — by transposing to change of resistance and measuring, existence of the stress-strain diagram in a substrate inner layer and a value are measured, and it is related with the printed wired board which made it possible to cancel the effects of various by distortion.
[0002]
[Description of the Prior Art] In an electrical part (electric equipment), a machine part, etc. which constitute current, and various kinds of precision mechanical equipments and machineries, visually, the check originated in the difficult cause and various failures have occurred. As such a cause, temperature, the MAG, static electricity, a stress-strain diagram, etc. can be mentioned. Change which originates in the cause of various failure generating and is generated, and a bad influence are the existences which cannot be measured simply, and in order to measure these, they need large-scale equipment in many cases. For example, about measurement of distortion by stress, generally measurement using a strain gage is performed and distortion measurement by this strain gage is carried out in many scenes at the machinery. A strain gage is a means to change physical quantity, such as a pressure, a load, and a variation rate, into an electrical signal as everyone knows, for example, when distortion joins resistors, such as a metal and a semi-conductor, it is a stress measurement means by which the piezoresistance effect that an electric resistance value changed was used.
[0003] By the way, although the printed wired board as an electrical part used for the electric equipment of various devices was performing distortion measurement when it attached this in a device by approaches, such as a screw bundle, conventionally, measuring distortion by the printed wired board itself did not almost have it. However, about the latest printed wired board, many minimum chips with which the case where many components are carried by high-density-assembly-ization increases and with which we are anxious about solder connection dependability in loading components, BGA which makes solder ball connection, CSP, etc. are contained increasingly. Each of these loading components is components with a possibility that the solder connectability between substrates may fall by slight distortion by the printed wired board itself. If it bends in a substrate and deformation of curvature etc. occurs by sheet metal-ization of the heat stress added at the stress by the weight of loading components, and the time of reflow connection and flow connection, and a printed wired board etc., various failures that a crack is formed in chips, such as a carried chip resistor, such as a chip crack, occur, and it is becoming impossible moreover, to disregard the effect resulting from distortion of a printed wired board. For this reason, it is necessary to form the cure which avoids faults, such as a faulty connection of components, and a fall of support stability, and to reduce the incidence rate of a defective by measuring and knowing distortion which joins the necessary part of a printed wired board beforehand, and the effect resulting from it. That is, by acquiring the data about distortion generated when a printed wired board is carried in the system, in a design stage, arrangement of components is changed or modification of selecting the substrate thickness which cannot deform easily is attained. By the way, although it is possible to stick a strain gage on the proper place of a printed wired board, for example, and to measure distortion as a means to measure distortion which joins a printed wired board etc. The problem of the tooth-space reservation which sticks a strain gage on the printed wired board by which densification was carried out, The problem from which distortion measurement in the attachment condition to a device becomes difficult since a printed wired board [having stuck the strain gage] cannot be attached to a device, Since it becomes measurement only

on the surface of a patchboard, there are a problem that a measurable part is limited to a part and becomes inadequate, a problem that the cost of the strain gage itself becomes high, etc.
[0004]
[Problem(s) to be Solved by the Invention] Let it be a technical problem to offer the printed wired board which enabled it to make this invention in view of the above, to measure existence of a stress-strain diagram and a value not only about the surface part of a substrate but about a inner layer part in case it measures changes of state, such as distortion by the stress produced in a printed wired board, by the strain gage, and to cancel the effects of various by distortion. Namely, although the strain gage used for distortion measurement of this invention consists of thin metallic foils which consist of the quality of the material equipped with the piezoresistance effect, minute resistance change generated in this metallic foil by distortion by stress etc. is changed into the amount of distortion and distortion is measured copper foil sticks on a printed wired board from the first at a inner layer -- having -- **** -- the same -- a inner layer -- a conductor -- metal boxes, such as a metallic foil with a big resistance change, for example, nickel etc., are prepared in an one-sheet inner layer, and it is thought possible by forming a strain gage in photo etching to give the role of a simple strain gage.
[0005]
[Means for Solving the Problem] the printed wired board which consists of the substrate with which invention of claim 1 carried out the laminating of two or more electric insulating plates in order to solve the above-mentioned technical problem, and the conductor pattern of this substrate formed in the surface at least -- setting -- the inner layer of the above-mentioned substrate -- a conductor -- resistance change is characterized by laying a big metallic foil underground. Invention of claim 2 is characterized by having arranged the electrode for measurement for connecting with the above-mentioned metallic foil on the surface of the above-mentioned substrate. invention of claim 3 -- the above -- a conductor -- resistance change is characterized by using nickel as a big metallic foil. Invention of claim 4 is characterized by forming the above-mentioned metallic foil on an electric insulating plate by photo etching. Invention of claim 5 is characterized by having arranged two or more above-mentioned metallic foils in the location of the arbitration on one electric insulating plate which constitutes the above-mentioned substrate. Invention of claim 6 is characterized by setting up the sense of each metallic foil in the many directions while it arranges two or more above-mentioned metallic foils on one electric insulating plate. Invention of claim 7 is characterized by having arranged the above-mentioned metallic foil, respectively in the location of the arbitration on a different electric insulating plate which constitutes the above-mentioned substrate. Invention of claim 8 is characterized by connecting the above-mentioned metallic foil and the electrode for measurement formed in the substrate surface in a through hole. Invention of claim 9 is characterized by forming by plating solder in the hole which formed the above-mentioned through hole in the above-mentioned substrate. the printed wired board which consists of the substrate with which invention of claim 10 carried out the laminating of two or more electric insulating plates, and the conductor pattern of this substrate formed in the surface at least -- setting -- a conductor -- resistance change arranges a big metallic foil, respectively at the front face of the above-mentioned substrate, and this front-face side metallic foil and a corresponding substrate rear face, and is characterized by connecting between both metallic foils in a through hole.
[0006]
[Embodiment of the Invention] Hereafter, this invention is explained to a detail according to the gestalt of operation shown in the drawing. Drawing 1 is the appearance perspective view of an example of the printed wired board which applied this invention, and number-of-sheets arrangement of the arbitration is carried out for the metallic foil (metallic foil gage) 10 used as a strain gage towards the location of the arbitration in the layer of arbitration, and the direction of arbitration at the inner layer of the printed wired board 1 formed by carrying out the laminating of the sheet metal (electric insulating plate) which consists of insulating materials, such as glass epoxy. That is, the printed wired board 1 is equipped with the inner layer conductor pattern 4 grade formed in the substrate 3 which carried out laminating unification and constituted the electric insulating plate 2 of two or more sheets, the surface conductor pattern formed in the front face or rear face of a substrate 3, and the between electric insulating plates (i.e., a substrate inner layer). As for each metallic foil 10, forming by photo etching is ideal for a configuration as shown in drawing 2 . distortion resulting from the stress to the printed wired board part by which the metallic foil 10 has been arranged can be electrically measured by connecting with the electrode which exposed the terminal areas 10a and 10b of the both ends of this metallic foil 10 to the surface (a front face or/, and rear face) of a patchboard, respectively, and connecting with the sense terminal of a measuring instrument which does not illustrate this electrode, respectively. As the quality of the material of a metallic foil 10,

metallic materials, such as nickel nickel equipped with the piezoresistance effect, for example, are used. even if it is except nickel as the quality of the material of a metallic foil 10 -- a conductor -- change of resistance can use a big metallic material. The reason for arranging a metallic foil 10 to the inner layer of a substrate 3 Since substrate external surface is utilized as a field of an element-placement tooth space and others in many cases By being because it being unable to continuing sticking a metallic foil 10, and forming a metallic foil 10 on an electric insulating plate 2 by technique, such as photo etching, at the time of printed wired board manufacture Building in the metallic foil as a strain gage is continued in the completed printed wired board, and it becomes possible also in after loading to a device to measure the generating situation of the distortion to a printed wired board at the stage of arbitration. By using a metallic foil 10 as a built-in strain gage, housekeeping and the procedure which it becomes unnecessary to secure the tooth space which it becomes unnecessary to prepare many strain gages like before, and is stuck, and stick or exfoliate also become unnecessary, and handling and measurement easy-ize them. Moreover, although only distortion of a surface part can be measured when a strain gage is stuck only on substrate external surface, distortion of the location of internal arbitration can also be correctly measured by arranging a metallic foil inside.

[0007] Drawing 3 is the important section sectional view of the printed wired board which applied this invention, and while the substrate 3 of the multilayer structure which carried out two or more sheet laminating of the electric insulating plate 2 which consists of insulating materials, such as glass epoxy, has the usual circuit pattern which changes from copper, aluminum, etc. to the front face or rear face, a circuit pattern is electrically connected with the internal pattern 4 which consists of the copper foil arranged through through hole 11a at the inner layer if needed. Through holes 11a, 11b, and 11c are formed the wall of the hole which does not penetrate or penetrate a substrate 3, and by covering solder etc. with plating to an opening periphery. The metallic foil 10 used as a strain gage is formed between the two-layer eye and the electric insulating plate 2 of the 3rd layer from the top with the gestalt of this operation, and two terminal areas 10a and 10b of a metallic foil 10 are electrically connected with the electrode 15 for measurement arranged on the substrate front face by through hole 11b which changes from the solder which carried out covering formation to the hole formed from the substrate front face, and this hole wall (connection). That is, while arranging the metallic foil 10 of the **** structure shown in drawing 2 to a inner layer, each terminal areas 10a and 10b are connected to the surface electrode 15 for measurement through through hole 11b, respectively. Where the sense terminal of the measuring instrument which is not illustrated is connected to the electrode 15 for measurement, it energizes to a metallic foil 10, and minute resistance change is changed into the amount of distortion, and distortion is measured. that is, -- the gestalt of this operation -- a conductor -- by connecting with the electrode 15 for measurement which formed the metallic foil 10 to which resistance change changes from a big metallic material in the substrate surface, after including this printed wired board in the electric equipment of the body of a device, it becomes possible the value of distortion which originated in stress at the stage of arbitration, and to measure that effect. as mentioned above, a conductor -- as a metallic material with a big resistance change, metallic foils, such as Nickel nickel, are desirable. As for this metallic foil 10, it is desirable like the process at the time of forming a conductor pattern on each electric insulating plate to form as a metallic foil gage by photo etching. That is, without using a high special technique, an installation cost and run INIGU cost can form easily at the usual printed wired board manufacturing technology, and do not cause the increase of a manufacturing cost.

[0008] Moreover, although not illustrated, two or more metallic foils 10 as this strain gage may be arranged in the location of the arbitration in the same layer, and its direction of each strain gage is good also as a condition that changed this according to distortion set as the object of measurement, and two or more metallic foils in the same inner layer have been arranged towards the many directions as a result. Consequently, the change of state in each location of a printed wired board can be transposed to electric resistance change, and can be measured, or a directive change of state can be transposed to electric resistance change, and can be measured. Furthermore, the metallic foil 10 as a strain gage may be arranged in a location to between different electric insulating plates (i.e., different arbitration of two or more inner layers). Consequently, the change of state of the thickness direction location of the arbitration in a inner layer and the change of state near a surface can be transposed to resistance change, respectively, and can be measured. Next, through hole 11c of the right end section in drawing 2 is a means to connect front-face side metallic foil 10A formed in the front face of a substrate 3, front-face side metallic foil 10A, and rear-face side metallic foil 10B formed in the corresponding substrate rear face. Since it has exposed to a substrate surface, the measurement which contacted the sense terminal of the measuring instrument which is not illustrated is possible for each terminal areas 10a and 10b of front-face

side metallic foil 10A and rear-face side metallic foil 10B. The usual printed wired board manufacturing technology can realize easily, such a configuration can be taken out outside by the ability making the change of state of the surface (a front face and rear face) of a substrate into an electrical signal, and measurement can be presented with it. It becomes possible to measure a change of state with a high precision by combining and using especially the metallic foil arranged, respectively for the front rear face of a substrate. In addition, if a highly precise measurement result is not desired, creating a metallic foil gage with the conventional wiring technique using the existing copper foil (for example, a sign 4 showing) arranged in a substrate 3 is also considered.

[0009]

[Effect of the Invention] This invention is using the printed wired board which built in the strain gage which consists of a metallic foil, and it becomes unnecessary to take into consideration the tooth space which it becomes unnecessary to prepare many strain gages, and is stuck on a substrate front face as mentioned above. Moreover, the need also of housekeeping and the procedure to stick is lost and it very becomes easy to treat. When a printed wired board is collectively attached to a product, it also becomes possible to perform distortion measurement if needed in the scene of arbitration. namely, -- according to invention of claim 1 -- a conductor -- since the big metallic foil of resistance change has been arranged to the inner layer of a substrate, a change of state with various printed wired boards resulting from external force etc. can be transposed to resistance change, and can be measured. the conductor which according to invention of claim 2 has arranged the electrode for measurement on the substrate surface (a front face or/and rear face), and has been arranged on it at the inner layer -- since it connected with the big metallic foil of resistance change, it can take out outside by making information about resistance change into an electrical signal. according to invention of claim 3 -- the above -- a conductor -- since metals, such as nickel, are used as a big metallic foil of resistance change, it is possible to form a metallic foil at the usual printed wired board production process, and productivity can be raised. According to invention of claim 4, since a metallic foil gage is formed by photo etching, an expensive complicated special technique cannot be used but it can form easily in the usual printed wired board manufacturing technology.

[0010] According to invention of claim 5, the metallic foil gage is arranged at two or more places of the same inner layer, and the change of state of each location of a lint substrate can be transposed to resistance change, and can be measured. According to invention of claim 6, the foil gage is arranged in the many directions in the same inner layer, a directive change of state is transposed to resistance change, and is measured, and the thing of it can be carried out. According to invention of claim 7, the metallic foil gage is arranged on two or more electric insulating plates which constitute a substrate, respectively, the change of state in a surface and a inner layer is measured, and the thing of it can be carried out. Since connection of a metallic foil and the electrode for measurement prepared in the surface is carried out in the through hole according to invention of claim 8, in the usual printed wired board manufacturing technology, easily, the path of an electrical signal is formed and the thing of it can be carried out. Since it formed by plating solder in the hole which formed the above-mentioned through hole in the above-mentioned substrate according to invention of claim 9, it can form easily at the usual printed wired board manufacturing technology, and a change of state can be taken out outside as an electrical signal. according to invention of claim 10, the metallic foil gage is arranged relatively at the topmost part (front face) and the bottom (rear face) of a substrate, respectively, and a change of state with a high precision is measured with such combination -- things can be carried out.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The appearance perspective view of an example of the printed wired board which applied this invention.
[Drawing 2] Drawing showing the example of a configuration of the metallic foil (metallic foil gage) as an example of this invention.
[Drawing 3] The sectional view of the printed wired board of this invention.
[Description of Notations]
1 A printed wired board, 2 An electric insulating plate, 3 A substrate, 4 A inner layer conductor pattern, 10 A metallic foil (metallic foil gage), 10a, 10b Terminal area, 11a, 11b, 11c A through hole, 15 Electrode for measurement.

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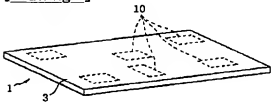
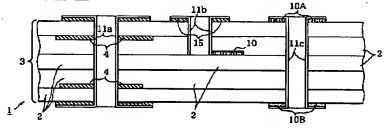
DRAWINGS

[Drawing 1]



[Drawing 2]

[Drawing 3]



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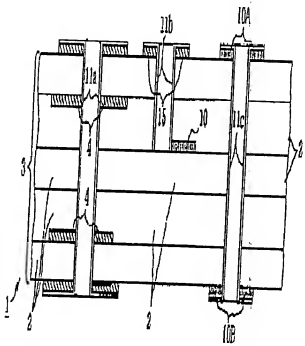
(54)【発明の名称】　プリント配線板

(57)【要約】
【課題】　プリント配線板に生じる応力による歪み等の状態変化を歪みゲージにより測定する際に、基板の表層部分のみならず、内層部分についても応力歪みの存在、値を計測して、歪みによる種々の影響を解消することを可能としたプリント配線板を提供する。
【解決手段】　複数の絶縁板２を積層した基板３と、該基板の少なくとも表層に形成した導体パターンとから成るプリント配線板１において、基板の内層に、導体抵抗変化が大きな金属箔１０を埋設した。基板の表層に、上記金属箔と結線するための測定用電極１５を配置した。



【特許請求の範囲】

【請求項１】　複数の絶縁板を積層した基板と、該基板の少なくとも表層に形成した導体パターンとから成るプリント配線板において、

上記基板の内層に、導体抵抗変化が大きな金属箔を埋設したことを特徴とするプリント配線板。

【請求項２】　上記基板の表層に、上記金属箔と結線するための測定用電極を配置したことを特徴とする請求項１記載のプリント配線板。

【請求項３】　上記導体抵抗変化が大きな金属箔として、ニッケルを用いたことを特徴とする請求項１又は２記載のプリント配線板。

【請求項４】　上記金属箔を、フォトエッチングにより絶縁板上に形成したことを特徴とする請求項１、２又は３記載のプリント配線板。

【請求項５】　上記金属箔を、上記基板を構成する一つの絶縁板上の任意の位置に複数配置したことを特徴とする請求項１、２、３、又は４記載のプリント配線板。

【請求項６】　上記金属箔を、一つの絶縁板上に複数配置すると共に、各金属箔の向きを多方向に設定したことを特徴とする請求項１、２、３、４、又は５記載のプリント配線板。

【請求項７】　上記金属箔を、上記基板を構成する異なった絶縁板上の任意の位置に夫々配置したことを特徴とする請求項１、２、３、４、５又は６記載のプリント配線板。

【請求項８】　上記金属箔と、基板表層に形成した測定用電極とをスルーホールにて結線したことを特徴とする請求項１、２、３、４、５、６、又は７記載のプリント配線板。

【請求項９】　上記スルーホールを、上記基板に形成した穴内に半田をメッキすることにより形成したことを特徴とする請求項１、２、３、４、５、６、７又は８記載のプリント配線板。

【請求項１０】　複数の絶縁板を積層した基板と、該基板の少なくとも表層に形成した導体パターンとから成るプリント配線板において、

導体抵抗変化が大きな金属箔を、上記基板の表面と、該表面側金属箔と対応する基板裏面に、夫々配置し、両金属箔間をスルーホールにて結線したことを特徴とするプリント配線板。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、プリント配線板に生じる応力による歪み等の状態変化を配線板内層に設けた金属体の導体抵抗の変化に置き換えて測定することにより、基板内層における応力歪みの存在、値を計測して、歪みによる種々の影響を解消することを可能としたプリント配線板に関する。

【０００２】

【従来の技術】現在、各種の精密機器や機械装置を構成する電気部品（電装部）、機械部品等に於いて、目視では確認が困難な原因に起因してさまざまな障害が発生している。このような原因として、例えば温度、磁気、計電気、応力歪み等を挙げることができる。各種障害発生の原因に起因して発生する変化、悪影響は、単純に計測することが不可能な存在であり、これらを測定するためには大がかりな装置を必要とする場合が多い。例えば、応力による歪みの計測に関しては、歪ゲージを用いた計測が一般的に行われており、機械装置等では、多くの場面でこの歪みゲージによる歪み測定が実施されている。歪みゲージは、周知のように圧力、荷重、変位等の物理量を電気信号に変換する手段であり、例えば金属、半導体等の抵抗体に歪みが加わった時に電気抵抗値が変化するという圧抵抗効果を利用した応力測定手段である。

【０００３】ところで、各種機器の電装部に使用される電気部品としてのプリント配線板は、従来これをネジ締め等の方法によって機器に取り付ける際に歪み測定を行ってはいたものの、プリント配線板そのものの歪みを測定することはほとんどなかった。しかし、最近のプリント配線板については、高密度実装化により多数の部品が搭載される場合が多くなり、また、搭載部品の中には、半田接続信頼性が懸念される極小チップ部品や、はんだボール接続を行うＢＧＡやＣＳＰ等が多く含まれるようになってきている。これらの搭載部品は、いずれもプリント配線板自体の僅かな歪みによって、基板との間の半田接続性が低下する虞れのある部品である。また、搭載部品の重量によるストレスや、リフロー接続時やフロー接続時に加わる熱ストレス、プリント配線板の薄板化等により、基板に撓み、反り等の変形が発生すると、搭載したチップ抵抗等のチップ部品にクラックが形成されるチップクラック等のさまざまな障害が発生し、プリント配線板の歪みに起因した影響を無視できなくなってきている。このため、予めプリント配線板の所要箇所に加わる歪みと、それに起因した影響を測定して知っておくことにより、部品の接続不良や、支持安定性の低下等といった不具合を回避する対策を立てて、不良品の発生率を低減する必要がある。即ち、プリント配線板を実機に搭載した際に発生する歪みに関するデータを取得しておくことにより、設計段階において、部品の配置を変更したり、変形しにくい基板厚を選定する等の変更が可能となる。ところで、プリント配線板等に加わる歪みを測定する手段としては、例えば歪みゲージをプリント配線板の適所に貼って歪みの計測を行うことが考えられるが、高密度化されたプリント配線板上に歪みゲージを貼るスペース確保の問題、歪みゲージを貼ったままのプリント配線板を機器に組み付けることができない為に機器への組み付け状態での歪み測定が困難となる問題、配線板の表層のみでの測定となるため測定可能箇所が局所に限定されて不十分となるという問題、また歪みゲージ自体のコ

ストが高くなるという問題等がある。

【０００４】

【発明が解決しようとする課題】本発明は上記に鑑みてなされたものであり、プリント配線板に生じる応力による歪み等の状態変化を歪みゲージにより測定する際に、基板の表層部分のみならず、内層部分についても応力歪みの存在、値を計測して、歪みによる種々の影響を解消することを可能としたプリント配線板を提供することを課題とする。即ち、本発明の歪み測定に使用される歪みゲージは、圧抵抗効果を備えた材質から成る薄い金属箔にて構成されており、応力による歪み等により該金属箔に発生する微小抵抗変化を歪み量に変換して歪みを測定するが、プリント配線板にはもともと内層に銅箔が貼られており、同様に内層に導体抵抗変化が大きな金属箔、例えばＮｉ等の金属箔を一枚内層に設け、フォトエッチングにて歪みゲージを形成することによって簡易な歪みゲージの役割を持たせることが可能と考えられる。

【０００５】

【課題を解決するための手段】上記課題を解決する為、請求項１の発明は、複数の絶縁板を積層した基板と、該基板の少なくとも表層に形成した導体パターンとから成るプリント配線板において、上記基板の内層に、導体抵抗変化が大きな金属箔を埋設したことを特徴とする。請求項２の発明は、上記基板の表層に、上記金属箔と結線するための測定用電極を配置したことを特徴とする。請求項３の発明は、上記導体抵抗変化が大きな金属箔として、ニッケルを用いたことを特徴とする。請求項４の発明は、上記金属箔を、フォトエッチングにより絶縁板上に形成したことを特徴とする。請求項５の発明は、上記金属箔を、上記基板を構成する一つの絶縁板上の任意の位置に複数配置したことを特徴とする。請求項６の発明は、上記金属箔を、一つの絶縁板上に複数配置すると共に、各金属箔の向きを多方向に設定したことを特徴とする。請求項７の発明は、上記金属箔を、上記基板を構成する異なった絶縁板上の任意の位置に夫々配置したことを特徴とする。請求項８の発明は、上記金属箔と、基板表層に形成した測定用電極とをスルーホールにて結線したことを特徴とする。請求項９の発明は、上記スルーホールを、上記基板に形成した穴内に半田をメッキすることにより形成したことを特徴とする。請求項１０の発明は、複数の絶縁板を積層した基板と、該基板の少なくとも表層に形成した導体パターンとから成るプリント配線板において、導体抵抗変化が大きな金属箔を、上記基板の表面と、該表面側金属箔と対応する基板裏面に、夫々配置し、両金属箔間をスルーホールにて結線したことを特徴とする。

【０００６】

【発明の実施の形態】以下、本発明を図面に示した実施の形態に従って詳細に説明する。図１は本発明を適用したプリント配線板の一例の外観斜視図であり、ガラスエポキシ等の絶縁材料から成る薄板（絶縁板）を積層して形成されたプリント配線板１の内層には歪みゲージとして使用される金属箔（金属箔ゲージ）１０が、任意の層内の任意の位置、かつ任意の方向に向けて任意の枚数配置されている。即ち、プリント配線板１は、複数枚の絶縁板２を積層一体化して構成した基板３と、基板３の表面或は裏面に形成された表層導体パターンと、絶縁板間、即ち基板内層に形成された内層導体パターン４等を備えている。個々の金属箔１０は、例えば図２に示すような形状にフォトエッチングによって形成することが理想的である。この金属箔１０の両端の端子部１０ａ、１０ｂを夫々配線板の表層（表面或は／及び裏面）に露出した電極に接続し、該電極を図示しない測定器の測定端子に夫々接続することにより、金属箔１０が配置されたプリント配線板部分に対する応力に起因した歪みを電気的に測定することができる。金属箔１０の材質としては、例えば圧抵抗効果を備えたニッケルＮｉ等の金属材料を用いる。金属箔１０の材質としては、Ｎｉ以外であっても、導体抵抗の変化が大きな金属材料を使用することができる。金属箔１０を基板３の内層に配置する理由は、基板外面は部品搭載スペースその他の領域として活用されていることが多いので、金属箔１０を貼り続けることができない為であり、プリント配線板製造時にフォトエッチング等の手法により絶縁板２上に金属箔１０を形成することにより、完成したプリント配線板内に歪みゲージとしての金属箔を内蔵し続け、機器に対する搭載後においても、プリント配線板に対する歪みの発生状況を任意の時期に測定することが可能となる。内蔵型の歪みゲージとして金属箔１０を使用することにより、従来のように歪みゲージを多数準備する必要がなくなり、貼り付けるスペースを確保する必要もなくなり、また貼り付けたり剥離する段取り、手順も不要となり、取扱い、測定作業が容易化する。また、基板外面のみに歪みゲージを貼った場合には表層部分の歪みしか測定できないが、内部に金属箔を配置することにより、内部の任意の位置の歪みも正確に測定することができる。

【０００７】図３は本発明を適用したプリント配線板の要部断面図であり、ガラスエポキシ等の絶縁材料から成る絶縁板２を複数枚積層した多層構造の基板３は、その表面または裏面に銅、アルミ等から成る通常の配線パターンを有すると共に、必要に応じて配線パターンはスルーホール１１ｅを介して内層に配置された銅箔等から成る内部パターン４と電気的に接続される。スルーホール１１ｅ、１１ｂ、１１ｃは、基板３を貫通、或は貫通しない穴の内壁と、開口部周縁に半田等をメッキにより被覆することにより形成する。歪みゲージとして使用される金属箔１０は、この実施の形態では上から２層目と３層目の絶縁板２間に形成されており、金属箔１０の２つの端子部１０ａ、１０ｂは、基板表面から形成された穴と該穴内壁に被覆形成した半田とから成るスルーホール

１１ｂにより、基板表面に配置した測定用電極１５と電気的に接続（結線）されている。つまり、図２に示した如き構造の金属箔１０を内層に配置すると共に各端子部１０ａ，１０ｂをスルーホール１１ｂを介して表面の測定用電極１５に夫々接続する。図示しない測定器の測定端子を測定用電極１５に接続した状態で金属箔１０に通電して微小抵抗変化を歪み量に変換して歪みを測定する。つまり、この実施の形態では、導体抵抗変化が大きな金属材料から成る金属箔１０を基板表層に設けた測定用電極１５と結線することにより、このプリント配線板を機器本体の電装部に組み込んだ後においても、任意の時期に応力に起因した歪みの値と、その影響を測定することが可能となる。上述のように、導体抵抗変化が大きな金属材料としては、ニッケルＮｉ等の金属箔が好ましい。この金属箔１０は、個々の絶縁板上に導体パターンを形成する際の工程と同様に、フォトエッチングにより金属箔ゲージとして形成することが好ましい。つまり、設備費やランイニングコストが高い特殊技術を用いずに、通常のプリント配線板製造技術にて容易に形成することができ、製造コスト増を招くことがない。

【０００８】また、図示しないが、この歪みゲージとしての金属箔１０は、同一の層内の任意の場所に複数配置してもよいし、個々の歪みゲージの方向は、測定の対象となる歪みに応じてこれを異ならせ、結果として同一内層内の複数の金属箔が多方向に向けて配置された状態としてもよい。この結果、プリント配線板の各位置における状態変化を電気抵抗変化に置き換えて測定したり、方向性のある状態変化を電気抵抗変化に置き換えて測定することができる。更に、歪みゲージとしての金属箔１０を異なった絶縁板間、つまり異なった複数の内層の任意に位置に配置してもよい。この結果、内層における任意の厚み方向位置の状態変化や、表層付近の状態変化を夫々抵抗変化に置き換えて測定することができる。次に、図２中の右端部のスルーホール１１ｃは、基板３の表面に形成した表面側金属箔１０Ａと、表面側金属箔１０Ａと対応する基板裏面に形成した裏面側金属箔１０Ｂとを接続する手段である。表面側金属箔１０Ａ及び裏面側金属箔１０Ｂの各端子部１０ｅ，１０ｂは、基板表層に露出しているので、図示しない測定器の測定端子を当接した測定が可能である。このような構成は、通常のプリント配線板製造技術により容易に実現することができ、基板の表層（表面及び裏面）の状態変化を電気信号として外部に取り出して測定に供することができる。特に、基板の表裏面に夫々配置した金属箔を組み合わせ使用することにより、精度の高い状態変化を測定することが可能となる。なお、高精度の測定結果を望まなければ、基板３内に配置された既存の銅箔（例えば符号４で示す）を用いて従来の配線技術により金属箔ゲージを作成することも考えられる。

【０００９】

【発明の効果】以上のように本発明は、金属箔から成る歪みゲージを内蔵したプリント配線板を使うことで、歪みゲージを多数準備する必要がなくなり、また基板表面に貼るスペースを考慮する必要もなくなる。また貼る段取り、手順も必要がなくなり、非常に扱いやすくなる。併せてプリント配線板が製品に組み付けられた場合は、任意の場面で必要に応じて歪み測定を行うことも可能になる。即ち、請求項１の発明によれば、導体抵抗変化の大きな金属箔を基板の内層に配置したので、外部応力等に起因したプリント配線板の様々な状態変化を抵抗変化に置き換えて測定することができる。請求項２の発明によれば、基板表層（表面又は／及び裏面）に、測定用電極を配置し、内層に配置した導体抵抗変化の大きな金属箔と結線したので、抵抗変化についての情報を電気信号として外部に取り出すことができる。請求項３の発明によれば、上記導体抵抗変化の大きな金属箔としてＮｉ等の金属を用いているので、通常のプリント配線板製造工程にて金属箔を形成することが可能であり、生産性を高めることができる。請求項４の発明によれば、フォトエッチングにより金属箔ゲージを形成するので、複雑高価な特殊技術を使わず、通常のプリント配線板製造技術にて安易に形成することができる。

【００１０】請求項５の発明によれば、同一内層の複数箇所に金属箔ゲージが配置されており、リント基板の各位置にての状態変化を抵抗変化に置き換え測定することができる。請求項６の発明によれば、同一内層内に多方向に箔ゲージが配置されており、方向性のある状態変化を抵抗変化に置き換え測定することできる。請求項７の発明によれば、基板を構成する複数の絶縁板上に夫々金属箔ゲージが配置されており、表層、内層におけるところの状態変化を測定することできる。請求項８の発明によれば、金属箔と表層に設けた測定用電極とがスルーホールにて結線されているので、通常のプリント配線板製造技術にて安易に電気信号の経路を形成することできる。請求項９の発明によれば、上記スルーホールを、上記基板に形成した穴内に半田をメッキすることにより形成したので、通常のプリント配線板製造技術にて安易に形成でき、電気信号として状態変化を外部に取り出すことができる。請求項１０の発明によれば、基板の最上部（表面）と最下部（裏面）に夫々金属箔ゲージが相対的に配置されており、これらの組み合わせにより精度の高い状態変化を測定することできる。

【図面の簡単な説明】

【図１】本発明を適用したプリント配線板の一例の外観斜視図。

【図２】本発明の一例としての金属箔（金属箔ゲージ）の構成例を示す図。

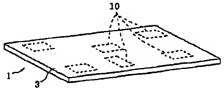
【図３】本発明のプリント配線板の断面図。

【符号の説明】

１　プリント配線板，２　絶縁板，３　基板，４　内層

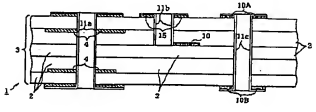
導体パターン．１０　金属箔（金属箔ゲージ），１０ｅ，１０ｂ　端子部．１１ｅ，１１ｂ，１１ｃ　スルーホール，１５　測定用電極．

【図１】



【図２】

【図３】



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